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PRODUCING METHANE GAS FROM ANIMAL WASTES

Heat energy from organic materials can be obtained by burning wood, straw, or cattle manure. Pound for pound, they produce about one-half the heat that coal does. These materials, however, must be dry for direct burning. But when they are converted to methane gas by anaerobic bacteria, they need not be dry and they are more satisfactory and convenient to use for such purposes as cooking and heating. Animal wastes are excellent input materials for making methane gas.

The conversion of animal wastes to methane gas is useful in areas where petroleum fuels are scarce. It is currently popular in India and Taiwan. The systems used there are relatively simple. Airtight tanks, called digesters, are partially filled with an animal-waste slurry. The tanks are capped and as the number of bacteria grows, methane and carbon dioxide accumulate in the air space above the slurry. The gas can be piped to gas burners or engines that drive electric generators. For small units, the digester tanks can also provide storage. For large units, separate gas storage tanks may be required.

The process has not been used in the United States because other less costly sources of energy have been readily available. Shortages of petroleum and rising fuel costs, however, could make the process more competitive. The technology needed to produce methane from manure on livestock farms in the United States will need to be tailored for specific types and sizes of farms. As yet, the researchers do not know whether the amount of methane produced, particularly on small farms, will be sufficient to justify equipment and operational costs.

For most farmers, animal waste collection, transportation, digester charging, and removal of spent materials must be mechanized. Because of the difficulty in transporting wastes, most of the gas would best be produced and used on the farm or ranch where the wastes are generated.

Techniques for using the gas must be developed. It can be burned like natural gas but some burner modification will probably be needed. Several municipal sewage systems have used methane gas produced in sewage digester tanks to operate electric generators. If the gas is to be used for internal combustion engines, the carburetion system must be modified. The separation of methane from carbon dioxide is not considered useful enough on a farm to justify its cost.

Safety standards apply to all aspects of the system. If improperly handled, the gas can explode. The life of common steel tanks and piping can also be shortened by the corrosiveness of the process. Digester and storage tanks must meet safety standards similar to those that are required for natural gas, but continuous use of the gas could eliminate the need for storage tanks.

Animal waste slurries that contain about 10 percent solids, such as those found below the slotted floors of cattle barns, have about the maximum solid content that can be used in a digester. Usually about 20 days are needed after first charging before much methane is produced. As much as 60 days may be required for full methane production. However, production time can be greatly shortened by (1) providing an initial charge of innoculant such as the residue from a previous batch, (2) maintaining high digester temperature, and (3) avoiding massive "shock" loadings of the digester.

Other conditions also affect gas production. An air-tight system is essential and a 90^{o} to 105^{o} F. temperature range is recommended. Production declines rapidly as the temperature drops below 60^{o}. Thus, in cold climates some of the methane produced will be needed to keep the digester tank warm. The amount of gas required to keep the tank warm will depend on outside air temperature, temperature of the input wastes, size of the tank, and tank insulation.

Energy will be needed to agitate the contents of the digester tank, to improve digestion, and to prevent a scum from sealing over the slurry. About one-half of the input solids will remain after digestion. Unless adequately mixed with the liquid, the spent solids may be difficult to remove because they settle and form a hard cake. The spent wastes usually contain about the same amount of nitrogen as the original input wastes and can be used to fertilize gardens or cropland.

Although gas (methane and carbon dioxide) yields may be as much as 12 cubic feet per pound of dry matter added, the actual yields of gas from animal wastes will usually be lower. The yields shown in the following table from various farm animals are considered more realistic.

Kind of Animal	Gas Production[1/]	Energy Value[2/]
	cu. ft. per day	Btu per day
1000 lb. milk cow	40.00	20,000
1000 lb. steer	30.00	15,000
100 lb. pig	3.00	1,500
5 lb. hen	0.3	150

1/ Calculated by multiplying approximate waste production rates by a gas production rate of about 6 cu. ft. per pound of dry matter added. Substantial variations may be expected in actual practice.

2/ Calculated at 500 Btu per cu. ft. of gas. If the gas is more than 50 percent methane, this figure may be increased proportionately. One-hundred percent methane produces about 1000 Btu per cu. ft.

The gas yields shown in the table may be compared to the energy requirements for the average home. In the average home, a gas furnace running at full capacity produces about 120,000 Btu per hour and approximately 1,500 Btu are needed to bring a gallon of cold water to a boil.